# School Zone Safety: Are We Pandering to Parents?

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## Abstract

An important facet of road safety research is the improvement of school zones given the concentration of young pedestrians and cyclists who are particularly vulnerable. Road authorities are under increasing pressure from school representatives and parents to install newer technologies such as radar-based speed display signs, rectangular flashing beacons, and LED enhanced signs based on an underlying assumption that safety will be improved. While isolated studies have shown that many of these extra-ordinary countermeasures yield quantifiable changes in driver behaviour, what is not well understood is whether collisions are subsequently reduced, or even if there was a pre-existing collision ‘problem’ in need of attention. It is imperative that the traffic engineering community develop a better understanding of the relative magnitude of school zone collisions to provide a baseline upon which usage guidelines for non-traditional countermeasures can be developed.

This study synthesizes the results of a collision analysis for delineated urban school ‘zones’ and rural school ‘areas’ in the province of New Brunswick. The research was undertaken in the context that speed display units are being indiscriminately installed at area school sites with little or no consideration for past collision history, pre-existing speed profiles, traffic volumes, pedestrian volumes, or site-specific characteristics.

All urban schools from two of the largest cities in NB and a representative sample of rural schools were included in the analysis which captured up to 16 years of collision data for all severity levels (property damage only, injury and fatality). Observed collision rates within the school zones were contrasted against expected rates to identify those locations that underperformed. Predictive independent variables were identified in order to isolate those factors that should serve as markers for inclusion in usage guidelines for countermeasures.

Study results indicate that only 19% of delineated urban school zones/areas and 29% of rural zones/areas perform statistically worse than comparable road/street facilities outside of the influence of school operations. Similarly, 55% and 33% of urban and rural school zones/areas, respectively, are performing statistically better than expected. Study findings relating site characteristics to underperformance were inconclusive.

# 1.0 Introduction

Improving safety within school zones is a high priority for many jurisdictions given the higher volume of child pedestrians and cyclists who are particularly vulnerable due to their lack of experience with traffic. Improving safety in school zones could also encourage children to use active transportation modes (walking, cycling, etc.) to school because parents/guardians are more likely to allow their kids to participate in these activities when road conditions are safer. This would lead to more active children as well as fewer vehicles on the road, creating healthier and more sustainable communities (D'Amours Ouellet & Cloutier 2014). A more fundamental question for road authorities to address when dealing with the issue of school zones, however, is whether or not safety is a real or perceived concern. There is a lack of evidence regarding collision experience within designated school zones to quantify whether a problem actually exists.

Parents and guardians of school-aged children who hold a misguided belief that school zones are "unsafe" are often the source of pressure on school representatives on roadway authorities to improve school zone safety. In response, many road authorities have implemented costly countermeasures such as radar speed display boards and flashing beacons under the premise that safety will be improved. These measures are being taken to make school zones "safer" in the absence of empirical evidence that supports the assumption that school zones are, in fact, problematic. Many of the countermeasures have been shown through research to have significant impacts on driver behaviour that could contribute to safety outcomes; however, there is little evidence on their ability to reduce collision frequencies.

This paper strives to quantify existing safety performance of school zones by analyzing collision experiences within delineated school zones and areas in the province of New Brunswick. School locations in both rural and urban locations were analyzed to provide an overall understanding of how their collision performance compares to the road system outside of delineated school zones/areas.

Roads adjacent to schools are typically designated as either school "areas" or school "zones". The Transportation Association of Canada (TAC) defines a school *area* as "a section of roadway adjacent to a school that is denoted by school area signing only" (TAC, 2006). A school *zone* is defined as "a section of roadway adjacent to a school that is denoted by school area signing and a reduced speed limit sign". Whether a school is established as a zone or an area is determined by municipalities who base their decision on the TAC guidelines which are contingent on criteria that characterize the surroundings of a school on the level of safety they provide. Such criteria include school type, road classification, presence of fencing, property line separation, type of school entrance, and location of any sidewalks. These criteria are weighted based on safety; a higher weighting would indicate a greater need for the school to be designated as a 'zone' rather than an 'area'. Although the guidelines are somewhat subjective, they are an attempt to standardize signing and marking treatments for schools.

With respect to the list of criteria the highest weighted school location would be an elementary school, located on a local road, is fully traversable, with a property line that abuts the roadway, where the main entrance is the closest point to the adjacent roadway, and has no sidewalks present. The lowest weighted location where a school would be designated as an 'area' would be a high school, located on a major arterial or freeway, is non-traversable, with a property line separation of greater than 50 metres, has no school entrance abutting the adjacent roadway, and has sidewalks present on both sides of the adjacent roadway.

## 2.0 Literature Review

Little research has explored the linkage between school zones/areas and collisions in an effort to understand if there is underperformance of these facilities. A literature review was conducted to address this issue or closely related issues that could be correlated back to the current study.

According to a study by Schwebel, *et al.* (2011), children are at greater risk of being injured as a result of traffic collisions because they have not yet developed the motor tasks required to handle traffic and that risk increases near schools because of higher exposure rates. Their primary recommendation for ensuring child pedestrian safety is to provide children with traffic safety education, however, this only works to some extend because of a child's natural development – they state that young children simply cannot gain the necessary skills. Beyond training, they recommend engineered roads that include traffic calming techniques – such techniques would include radar speed display boards, which will be further explored as part of the current study. This research, although relevant, lacked analysis of crash rates involving child pedestrians experienced in school zones explicitly.

A more specific study by Warsh, *et al.* (2009) examined the number of collisions exclusively in school zones in Toronto, ON. Zones of differing radii were delineated around schools on ArcGIS in increments of 150m ranging from 0-150m to 301-450m. Their main conclusion was that the highest density of collisions involving child pedestrians (collisions/100 $km^2$) occurred in smallest zone and decreased as distance from a school increased. The density of collisions resulting in child injuries and fatalities were 5.7 and 9.4 times greater, respectively, within the smallest delineated zone compared to outside the furthest extent. They recommend further research be done focusing on midblock crossing locations in school zones, as this was the location with the greatest frequency of collisions. This study only examined child pedestrian involved collisions and did not analyze total collision occurrences within school zones. All collisions that occurred within predetermined circular zones were considered to have occurred within a school zone rather than actually having happened with an actual traffic school zone delineated on an adjacent street. The current study will examine collisions occurring within designated school zones only.

Collision experience within school zones should be better understood so that potential safety hazards to child pedestrians can be addressed. Armstrong and Petch (2013) proposed an evaluation framework to identify traffic risks to child pedestrians that warranted bussing of the children to school. They identified lack of separation from traffic as the factor most connected to pedestrian collisions and, therefore, stated that areas of greatest risk were those without walking facilities and/or shoulders. Accesses and driveways were acknowledged as another concern for child pedestrian safety because of possible conflicts between vehicles. The final concern mentioned within this study was stopping sight distance. If a distance did not provide drivers with the proper amount of time to stop for a child pedestrian, it posed a serious risk to the child. A "Hazard Evaluation Flowchart" was created based on the findings to warrant use of buses because of unsafe road conditions for children walking to school. Characteristics found in this study to pose a significant safety threat to children along their route to school may be interchangeable to school zones themselves, making it applicable to the current study.

It is clear from the literature reviewed that more in-depth research is needed to quantify collision experiences in school zones/areas. The few studies found related to the topic focused mainly on child pedestrians in the context of collisions involving child pedestrians that occurred at certain distances from schools or hazards present that could potentially affect child pedestrian safety. Children are the overall motivation for improving safety in school zones but it would still be beneficial to analyze all collision experiences in school zones to understand motorist behaviours in school zones/areas. The current study tries to address some of these deficiencies.

# 3.0 Methodology

The study involves the analysis of motor vehicle collision data for the province of New Brunswick. The following will present the methodology used for data collection and analyses of both urban and rural school locations involved in this study.

## 3.1 Data Collection

Motor vehicle collision data for the province of New Brunswick were collected by police departments at the time of a collision. Reporting thresholds in NB are for all collisions resulting in property damage in excess of $1,000 or if there is a personal injury. The data collected were received in the form of police reports from the New Brunswick Department of Transportation and Infrastructure (NBDTI) for the years 1997-2012. Reports contained all collisions that had police involvement; for research purposes it was assumed that recorded collisions were representative of all collisions that have occurred. A sample of schools was chosen for analyzing collision histories. The sample consisted of 31 urban and 24 rural schools assumed to be a representative sample of all schools in New Brunswick. The process of sample selection and filtering collision history data was done using two separate methods for urban and rural school zones, as described below.

### *3.1.1 Urban Schools*

The sample of urban schools consisted of all public schools from elementary to high school in two of the major cities within New Brunswick, Fredericton and Moncton. The sample of urban schools included both those with school “zones” delineated as well as “areas” (as defined by TAC). A portion of the schools had both a zone and an area –typically on different streets when located on a corner lot. Schools within these two cities were selected as the urban sample because the traffic departments from each city plot the collisions from the police reports that occurred within the respective city using GIS software (ArcGIS). School zone/area lengths were delineated on a GIS layer for each location and collisions occurring within the designated zones/areas were selected. This made it easier to identify specific collisions that occurred within the school zones as they could be identified directly on the map. This eliminated the chance of error when searching for collisions that had occurred within a school zone manually. Specific case numbers for the selected collisions within the GIS dataset correspond with the case numbers provided associated with the more detailed NBDTI reports. The information in the reports were analyzed for each case and only those collisions occurring between 7:30am to 4:30pm and from September to June were included as these restricted data to only those that occurred within school operating times. GIS-based data were only available from 2007 to 2014 for Fredericton collisions; data for Moncton included the years 1997 to 2012.

### *3.1.2 Rural Schools*

Collisions occurring within rural school areas were isolated by manually filtering them from the NBDTI database. A sample size of 24 rural school locations within New Brunswick were selected at random (while ensuring a reasonable geographic coverage) and location information for each area was retrieved. The rural schools sampled were also a mixture of school “zones” or “areas” (as defined by TAC). The distance of each rural school zone/area was delineated on a map. The NBDTI data were filtered by network component names of those that contained the sample school areas and then further reduced based on known distances to nearby network components. Only those collisions occurring between 7:30am to 4:30pm and from September to June were included for the years 1997 to 2012.

### 3.2 Analysis

The expected number of annual collisions to occur within each of the school locations under study was determined using different sources of Safety Performance Functions (SPF) representing similar street/facilities outside of a delineated school zone/area. A different SPF was used for each road facility type required: rural two-lane, undivided road segment; urban two-lane, undivided road segment; and all combinations of 3 and 4-legged and signalized and unsignalized intersections. The first set of SPF models used was from the Highway Safety Manual (HSM) (AASHTO, 2010). The second series of SPF models were developed by Sayed *et al.* (2008) for the Engineering Branch of the British Columbia Ministry of Transportation and Infrastructure. Calibration factors were determined for each model to adjust for jurisdictional differences. The calibration factors for each of the equations used were determined using the methodology described in the HSM Volume 2, Appendix A.1.

The road facility types that would be required for this analysis were first identified – all facility types described previously required calibration. Typically, a total of 30 sample sites not related to the school zones/areas were selected for each road facility type and collision data retrieved. The predicative models were applied to each sample site then the calibration factor was calculated. Calibration factors for all SPF models can be found in Table 1.

Average Annual Daily Traffic (AADT) volumes in vehicles per day were provided by the City of Fredericton and the City of Moncton for all urban roadways and by the New Brunswick Department of Transportation and Infrastructure for rural roadways. The AADT volumes are not collected on an annual basis and the values provided by the respective jurisdictions were assumed to be representative of the years of collision data being analyzed. School zone/area lengths were determined by locating each zone/area on Google Maps and using the measuring tool option available.

The expected annual collisions calculated for each of the schools analyzed were calibrated for local conditions and then multiplied by a reduction factor to estimate the expected annual collisions during school operating times. This factor was determined using the average distribution of annual collisions occurring from Monday to Friday, September to June, and 7:30am to 4:30pm divided by the total annual collisions occurring for six years. Derived reduction factors can be found in Table 2.

Total observed collision frequencies were converted to actual annual collision frequencies by dividing the total number of collisions by the number of years of collision data analyzed. These values were compared to the expected annual collisions for each location. A *Potential For Improvement* (PFI) was determined for each site by finding the difference between actual and expected annual collisions. A negative PFI indicates that the school zone/area is performing better than expected in terms of collisions. All schools were ranked from highest to lowest in terms of PFI (worst to best); this was done separately for rural and urban locations.

Statistical methods were used to analyze PFI values of the school; z-tests were used for urban schools ($n>30$) and t-tests were used for rural schools ($n<30$). Results of statistical analyses were used to determine which school zones and areas are statistically different ("worse" or "better") compared to the entire group of schools. Site characteristics were specified for school locations and compared between those classified as worse or better in terms of collision occurrences. These characteristics were considered as possible factors affecting school zone safety.

## 4.0 Results and Discussion

Results for the collision analyses of urban and rural school zones and areas can be found in Tables 3 and 4, respectively. PFI values for school locations highlighted in red indicate where a school is performing worse than expected with respect to collision frequency; alternatively, those highlighted in green indicate if a school is performing better than expected. Again, the baseline used to represent the 'norm' is the expected collision frequency for the same road facility type outside of a designated school zone/area. It should be noted that many of the SPFs do not include independent variables that account for pedestrian activity. In the context of school zones/areas there is often more pedestrian activity than normal (at least in the urban context) so it is likely the expected collision frequencies generated are perhaps low. This would have the consequence of inflating the PFIs generated by this study. In other words, the percentage of school zones/areas found to be underperforming might be slightly overestimated.

Results from the statistical analyses for urban and rural schools can also be found in Tables 3 and 4, respectively. Values highlighted in red indicate those schools performing statistically significantly worse than others while those highlighted in green indicate schools performing statistically significantly better. Statistical results are reported for 5% levels of significance. Table 5 shows the percent distribution of collision configurations for urban and rural schools.

### 4.1 Urban Schools

The data in Table 3 indicate that 14 of the 31 urban schools analyzed had a positive PFI - meaning 45% of urban schools have a greater number of observed annual collisions than the number of annual collisions that should be expected. Only 6 of these (19% -highlighted in red) were shown to be statistically significantly worse (at a 5% level of significance). Alternatively 17 (or 55%) of the urban schools were performing better than expected, all of which are statistically significant (55% -highlighted in green). Based on the initial results it is clear that on average, the urban school zones/areas studied are performing better than expected.

The average PFI for urban school zones was found to be 0.03 while it was 0.35 for urban school areas. While these values might suggest that school zones perform better than areas in urban environments, the results are not statistically significant. The average PFI for urban schools consisting of both a zone and an area was 0.29. No statistically significant difference was found between schools with both a zone and an area present compared to school consisting of a zone or an area only at a 5% significant level.

The data in Table 5 shows that the majority of collisions occurring in urban school zones/areas were rear-end or right-angle collisions. It is noteworthy that only 7% of all reported urban collisions involved a pedestrian.

There does not seem to be a clear difference in the city location of the school zones/areas that are performing statistically better or worse than expected. The City of Fredericton began installing radar speed display boards at school zones in 2009 as a countermeasure to safety concerns with respect to speeding. Installations were staged over the course of a few years, but there are currently 12 of the 17 schools equipped with display units installed. These units are placed in conjunction with the lowered posted speed limit of 30km/h at the thresholds of the school zone and display an oncoming motorists' speed as they approach the zone. The display will flash if the motorists' speed exceeds the speed limit by greater than 5km/h. The units are in operation from 7:30am to 4:00pm to capture school operating hours. The City of Moncton began posting a lowered speed limit sign of 30km/h and a flashing beacon in conjunction with standard school zone signage in 2006. A sign states to motorists' that the lowered speed limit is only effective when the flashing beacon is in operation. This occurs during the peak morning and afternoon periods when school aged pedestrian and cyclist activity is at its highest. The process of installing this countermeasure at all schools within the City of Moncton was completed by 2008. It would be beneficial to explicitly explore the impacts of these different safety measures on collision frequencies further by analyzing collision history data at each location before and after the measures were implemented. Statistical analyses should be performed to determine if collision frequencies are statistically significantly different once the measure was implemented.

The data summarized in Table 6 show the facility types present in each school zone/area. Those above the solid line are the schools performing worse than expected. It is notable that school zones/areas with intersections that are performing statistically worse than others tended to have much larger differences between volumes on the major and minor roadways that make up the intersection (a difference of 5000vph or more). Observations were made of other characteristics that may be contributing to urban schools performing worse than expected. Cursory analyses show that there are no characteristics that stand out as being predictive of higher collision frequencies. General observations are that school zones/areas performing worse, particularly in the City of Fredericton, tend to be located in more dynamic environments such as more central, downtown areas. Further analyses would be required to confirm these observations to make sound conclusions on contributing factors to safety in urban school zones/areas.

### 4.2 Rural Schools

Results from rural schools analyzed show 8 of the total 24 schools observed with a positive PFI, meaning that 33% of the schools were performing worse than expected. Statistical analyses show that 7 (29%) of the schools were performing statistically significantly worse than the others while 8 (33%) were performing statistically significantly better. Consequently, on average there does not seem to be any strong indication that rural school zones/area perform any better or worse than expected when compared to similar road facilities outside of the influence of schools. This indicates that rural schools should be examined independently for safety concerns.

The average PFI for rural school zones was found to be 0.008 while it was 0.000 for rural school areas. Not surprisingly, the results are not statistically significant.

Results from Table 5 show that the majority of collisions occurring in rural school zones and areas are a fairly even distribution between right-angle, rear-end, and single-vehicle. Again, a small proportion (only 7%) involved a pedestrian.

Characteristics of the rural schools analyzed can be found in Table 7. There are no obvious patterns with respect to characteristics present for schools performing worse or better than expected and no sound conclusions can be made regarding contributing factors. It was observed that rural schools that were designated as school zones that were performing better than expected had the lowered speed limit signs posted a few metres before the school area signs at the entrances to the area. The rural school zones that were performing worse than expected had the lowered speed limit signs posted either in conjunction with the school area sign at the entrances or a few metres after. Further analyses would be required to determine if this is a potential contributing factor to safety in rural school zones with a larger sample size. No pattern was found with respect to rural school areas.

## 5.0 Conclusions and Recommendations

Study results indicate that only 19% of urban school zones/areas and 29% of rural zones/areas perform statistically worse than comparable road/street facilities outside of the influence of school operations. Similarly, 55% and 33% of urban and rural school zones/areas, respectively, are performing statistically better than expected.

A comparison of the performance of school zones versus areas found there to be no statistical difference in their collision performance in either urban or rural areas. Urban schools consisting of both a zone and an area were also found to have no statistical difference in their collision performance when compared to urban schools classified as a zone or area only. Most collision types were either rear-end, right-angle or single vehicle. Only a small percentage of collisions (7% overall) involved pedestrians.

It is notable that both rural and urban schools are experiencing a higher percentage of right-angle and rear-ended collisions, however, only rural schools also had a high percentage of single-vehicle collisions. Non-traditional countermeasures such as radar speed display boards in the city of Fredericton or flashing beacons in the city of Moncton are being installed throughout most of the schools within their respective cities. Results from this study indicate that these measures may not be necessary at every school zone location.

A warrant system, or set of guidelines, for appropriate usage of extraordinary countermeasures would be beneficial to road authorities when deciding which school zones should be treated. Appropriate locations would include those that have a collision history indicating a significant potential for improvement. This proposed warrant system should be built on site characteristics of the school zones determined in this study to be performing worse than expected. A proper regression analysis should be performed on characteristics to determine those with the greatest predictive abilities of collision frequency.

It is recommended to analyze the schools involved in this study further by performing before and after studies of collision data for the urban school zones that had safety countermeasures installed. This would determine if the method of a reduced speed limit throughout a school zone during peak periods only indicated by a flashing beacon is more effective at reducing collision frequency than the method of radar speed display boards.

A more in-depth safety review of the schools involved in this study should be performed to determine other specific characteristics of each site that may be contributing factors to why a school is performing worse than expected. Ideally this would involve an in-person site inspection to observe potential factors that might get overlooked on a virtual inspection. This study applied Crash Modification Factors to adjust the SPFs (as described in the HSM) where deviation from base conditions for a specific site could be determined through virtual inspection only. The inclusion of all possible CMFs affecting the SPFs used for expected number of collisions is recommended where in-person site inspections are viable. Bayesian analyses are recommended to determine if safety is compromised with the presence of a school zone or if road segments and intersections in New Brunswick with similar characteristics are performing similarly independent of whether or not a school zone is present.

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# Tables

**Table 1 – Model Calibration Factors**

| | Facility Type | HSM Model | BC Model |
|---|---|---|---|
| **Fredericton** | Urban Road Segments (2-lane) | 0.95 | 0.62 |
| | Urban Road Segments (4-lane) | n/a | n/a |
| | Urban 3-leg Unsignalized Intersection | 0.92 | 0.96 |
| | Urban 3-leg Signalized Intersection | 0.51 | 0.50 |
| | Urban 4-leg Unsignalized Intersection | 0.77 | 0.90 |
| | Urban 4-leg Signalized Intersection | 1.08 | 1.03 |
| **Moncton** | Urban Road Segments (2-lane) | 0.94 | 0.54 |
| | Urban Road Segments (4-lane) | 1.03 | 1.45 |
| | Urban 3-leg Unsignalized Intersection | 0.56 | 0.78 |
| | Urban 3-leg Signalized Intersection | n/a | n/a |
| | Urban 4-leg Unsignalized Intersection | 1.31 | 1.73 |
| | Urban 4-leg Signalized Intersection | 1.37 | 1.31 |
| **Rural NB** | Road Segment (2-lane) | 0.83 | 0.45 |

**Table 2 – School Time Collision Distribution**

| City | Year | Total Collisions | Total Collisions (School Operating Times) | | School Time Collision Factor |
|---|---|---|---|---|---|
| **Fredericton** | 2012 | 1066 | 444 | | 0.42 |
| | 2011 | 1230 | 462 | | 0.38 |
| | 2010 | 1212 | 398 | | 0.33 |
| | 2009 | 1334 | 464 | | 0.35 |
| | 2008 | 1395 | 463 | | 0.33 |
| | 2007 | 1315 | 480 | | 0.37 |
| | | | | **Average:** | **0.36** |
| **Moncton** | 2012 | 1855 | 630 | | 0.34 |
| | 2011 | 2494 | 931 | | 0.37 |
| | 2010 | 2637 | 930 | | 0.35 |
| | 2009 | 2557 | 892 | | 0.35 |
| | 2008 | 2357 | 815 | | 0.35 |
| | 2007 | 2251 | 794 | | 0.35 |
| | | | | **Average:** | **0.35** |
| **Rural** | 2012 | 7957 | 2603 | | 0.33 |
| | 2011 | 9506 | 3391 | | 0.36 |
| | 2010 | 10096 | 3192 | | 0.32 |
| | 2009 | 10648 | 3552 | | 0.33 |
| | 2008 | 10238 | 3393 | | 0.33 |
| | 2007 | 9796 | 3343 | | 0.34 |
| | | | | **Average:** | **0.33** |

**Table 3 – Urban School Collision Analysis Results**

| School | City | Class | Actual Collisions /Yr | Expected Collisions /Yr | PFI | z-crit |
|---|---|---|---|---|---|---|
| George St | Fredericton | Zone/Area | 2.13 | 1.03 | 1.10 | -15.79 |
| Moncton High | Moncton | Area | 2.69 | 1.60 | 1.09 | -15.62 |
| Fredericton High School/Priestman | Fredericton | Zone | 1.38 | 0.64 | 0.74 | -9.84 |
| Garden Creek | Fredericton | Zone/Area | 0.88 | 0.27 | 0.61 | -7.92 |
| Hillcrest | Moncton | Zone/Area | 0.75 | 0.38 | 0.37 | -4.07 |
| Nashwaaksis Memorial | Fredericton | Zone/Area | 0.38 | 0.13 | 0.24 | -1.98 |
| Ecole Champlain | Moncton | Zone | 0.31 | 0.08 | 0.23 | -1.82 |
| Beavebrook | Moncton | Zone/Area | 0.88 | 0.68 | 0.20 | -1.34 |
| Forest Hill | Fredericton | Zone | 0.25 | 0.06 | 0.19 | -1.18 |
| Nashwaaksis Middle | Fredericton | Zone | 0.25 | 0.09 | 0.16 | -0.69 |
| Bliss Carman | Fredericton | Zone | 0.25 | 0.11 | 0.14 | -0.37 |
| Devon Middle | Fredericton | Zone | 0.25 | 0.14 | 0.11 | 0.11 |
| Harrison Trimble | Moncton | Area | 0.13 | 0.04 | 0.09 | 0.43 |
| Montgomery | Fredericton | Zone | 0.13 | 0.09 | 0.04 | 1.23 |
| Sunny Brae Middle | Moncton | Zone | 0.06 | 0.07 | -0.01 | 2.04 |
| Lewisville | Moncton | Zone | 0 | 0.02 | -0.02 | 2.2 |
| Evergreen Park | Moncton | Zone | 0 | 0.02 | -0.02 | 2.2 |
| Arnold H. McLeod | Moncton | Zone | 0 | 0.03 | -0.03 | 2.36 |
| Ecole Sainte-Bernadette | Moncton | Zone | 0.06 | 0.09 | -0.03 | 2.36 |
| Barker's Point | Fredericton | Zone | 0 | 0.05 | -0.05 | 2.68 |
| Forest Glen | Moncton | Zone | 0 | 0.05 | -0.05 | 2.68 |
| Park St | Fredericton | Zone | 0 | 0.05 | -0.05 | 2.68 |
| Ecole Le Sommet | Moncton | Zone | 0 | 0.06 | -0.06 | 2.84 |
| Connaught St | Fredericton | Zone | 0 | 0.08 | -0.08 | 3.16 |
| Northrop Frye | Moncton | Zone | 0 | 0.08 | -0.08 | 3.16 |
| Birchmount | Moncton | Zone | 0.13 | 0.21 | -0.08 | 3.16 |
| Royal Road | Fredericton | Area | 0 | 0.13 | -0.13 | 3.96 |
| Kingsclear | Fredericton | Zone/Area | 0.5 | 0.63 | -0.13 | 3.96 |
| Edith Cavell | Moncton | Zone | 0 | 0.16 | -0.16 | 4.44 |
| Liverpool St | Fredericton | Zone | 0 | 0.34 | -0.34 | 7.49 |
| Bessborough | Moncton | Zone/Area | 0.31 | 0.67 | -0.36 | 7.49 |

* Values highlighted in RED or GREEN are statistically significant at a 5% level of significance

**Table 4 – Rural School Collision Analysis Results**

| School | Location | Class | Actual Collisions/ Yr | Expected Collisions/ Yr | PFI | t-crit* |
|---|---|---|---|---|---|---|
| **Belleisle Regional High** | Rte 124 | Zone | 0.19 | 0.04 | 0.15 | -13.54 |
| **Millville Elementary** | Rte 104 | Area | 0.13 | 0.04 | 0.09 | -8.17 |
| **Lawrence Station Elem.** | Rte 003 | Zone | 0.13 | 0.05 | 0.08 | -7.27 |
| **Riverside Consolidated** | Riverside-Albert, NB | n/a | 0.06 | 0.01 | 0.05 | -4.59 |
| **Stanley High** | Rte 620 | Area | 0.06 | 0.02 | 0.04 | -3.69 |
| **Harvey High** | Rte 003 | Area | 0.06 | 0.03 | 0.03 | -2.80 |
| **Juniper Elementary** | Juniper Rd | n/a | 0.06 | 0.05 | 0.01 | -2.80 |
| **Central NB Academy** | Rte 008 | n/a | 0.06 | 0.05 | 0.01 | -1.01 |
| **Minto Elem.-Middle** | Cedar St | Area | 0 | 0.01 | -0.01 | 0.78 |
| **Blacks Harbour** | Rte 176 | Area | 0.06 | 0.07 | -0.01 | 0.78 |
| **Dorchester Consolidated** | Dorchester, NB | n/a | 0 | 0.01 | -0.01 | 0.78 |
| **Brown's Flat Elementary** | Brown's Flat, NB | Area | 0 | 0.01 | -0.01 | 0.78 |
| **Janeville Elementary** | Rte 340 | Area | 0 | 0.01 | -0.01 | 0.78 |
| **Pennfield Elementary** | Pennfield, NB | Area | 0 | 0.01 | -0.01 | 0.78 |
| **Ecole La Villa-Des-Amis** | Rte 011 | Area | 0.06 | 0.08 | -0.02 | 1.68 |
| **Millerton** | Rte 108 | Area | 0 | 0.02 | -0.02 | 1.68 |
| **Debec Elem.** | Debec Rd | n/a | 0 | 0.03 | -0.03 | 2.57 |
| **Cambridge-Narrows** | Lakeview Rd | n/a | 0 | 0.03 | -0.03 | 2.57 |
| **Miramichi Rural** | Rte 117 | Area | 0 | 0.03 | -0.03 | 2.57 |
| **Ecole Notre-Dame** | Rte 115 | Area | 0.06 | 0.10 | -0.04 | 3.47 |
| **Ecole La Decouverte-De-Saint-Sauveur** | Rte 160 | Zone | 0 | 0.06 | -0.06 | 5.26 |
| **Upper Miramichi Elem.** | Rte 625 | Zone | 0 | 0.06 | -0.06 | 5.26 |
| **Back Bay Elementary** | Rte 172 | Zone | 0 | 0.07 | -0.07 | 6.16 |
| **Bonar Law Mem. High** | Rte 134 | Zone | 0 | 0.09 | -0.09 | 7.95 |

* Values highlighted in RED or GREEN are statistically significant at a 5% level of significance

**Table 5 – Distribution of Collision Configurations**
(Percent)

| Collision Configuration | Urban | Rural | Combined |
|---|---|---|---|
| right angle | 44 | 40 | 43 |
| rear-end | 35 | 20 | 34 |
| single vehicle | 5 | 27 | 7 |
| pedestrian-involved | 7 | 7 | 7 |
| side-swipe | 4 | 0 | 3 |
| head-on | 2 | 7 | 3 |
| unknown | 2 | 0 | 2 |
| object | 1 | 0 | 1 |

**Table 6 – Urban School Zone Facility Type(s) by School**

| School | School Zone/Area Facility Type |
|---|---|
| **George St** | two road segments, 4-leg signalized intersection |
| **Moncton High** | road segments, 4-leg signalized intersection, 4-leg unsignalized intersection, four 3-leg unsignalized intersections |
| **Fredericton High School/Priestman** | two road segments, 3-leg signalized intersection, 3-leg unsignalized intersection |
| **Garden Creek** | two road segments, three 3-leg unsignalized intersections |
| **Hillcrest** | two road segments, two 3-leg unsignalized intersections |
| **Nashwaaksis Memorial** | two road segments, 3-leg unsignalized intersection |
| **Ecole Champlain** | road segment |
| **Beavebrook** | road segment, 4-lane road segment, 3-leg unsignalized intersection |
| **Forest Hill** | road segment |
| **Nashwaaksis Middle** | road segment, 3-leg unsignalized intersection |
| **Bliss Carman** | road segment |
| **Devon Middle** | three road segments, two 4-leg unsignalized intersection |
| **Harrison Trimble** | road segment, 3-leg unsignalized intersection, 3-leg all-way stop intersection |
| **Montgomery** | road segment |
| **Sunny Brae Middle** | road segment |
| **Lewisville** | road segment |
| **Evergreen Park** | road segment |
| **Arnold H. McLeod** | road segment, two 3-leg unsignalized intersections |
| **Ecole Sainte-Bernadette** | two road segments, 4-leg unsignalized intersection, 3-leg unsignalized intersection |
| **Barker's Point** | road segments, 3-leg unsignalized intersection |
| **Forest Glen** | two road segments, 3-leg unsignalized intersection |
| **Park St** | two road segments, four 3-leg unsignalized intersections |
| **Ecole Le Sommet** | road segment |
| **Connaught St** | road segment, two 3-leg unsignalized intersections |
| **Northrop Frye** | road segment, 3-leg unsignalized intersection |
| **Birchmount** | road segment, 3-leg unsignalized intersection, 3-leg all-way stop intersection |
| **Royal Road** | road segment |
| **Kingsclear** | two road segments, three 3-leg unsignalized intersections |
| **Edith Cavell** | two road segments, 4-leg all-way stop intersection |
| **Liverpool St** | two road segments, two 3-leg unsignalized intersection |
| **Bessborough** | two road segments, 4-leg unsignalized intersection, 4-leg all-way stop intersection, three 3-leg unsignalized intersections |

*All segments are 2-lane, 2-way and all unsignalized intersections are minor road stop control unless stated otherwise

**Table 7 – Rural School Area Characteristics by School**

| School | School Zone/Area Characteristics |
|---|---|
| **Belleisle Regional High** | Speed limit change from 80km/h to 50km/h (change in speed limit sign posted with school area sign at entrances), horizontal curve, narrow shoulder |
| **Millville Elementary** | No speed limit change (50km/h throughout), straight road segment |
| **Lawrence Station Elementary** | Speed limit change from 80km/h to 70km/h a few metres after school zone sign on one end, straight road segment |
| **Riverside Consolidated** | No school zone/area signs |
| **Stanley High** | No speed limit change (50km/h throughout) |
| **Harvey High** | No speed limit change (50km/h throughout) |
| **Juniper Elementary** | n/a |
| **Central NB Academy** | n/a |
| **Minto Elementary-Middle** | No speed limit change (50km/h throughout) |
| **Blacks Harbour** | No speed limit change (50km/h throughout) |
| **Dorchester Consolidated** | Turn off road to school from main road |
| **Brown's Flat Elementary** | No speed limit change (60km/h throughout) |
| **Janeville Elementary** | No speed limit change (80km/h throughout) |
| **Pennfield Elementary** | Turn off road to school from main road |
| **Ecole La Villa-Des-Amis** | No speed limit change (80km/h throughout) |
| **Millerton** | No speed limit change (80km/h throughout) |
| **Debec** | n/a |
| **Cambridge-Narrows** | No speed limit change (80km/h throughout) |
| **Miramichi Rural** | No speed limit change (80km/h throughout) |
| **Ecole Notre-Dame** | No speed limit change, nicer road, flashing beacons for pedestrian crossing adjacent to school |
| **Ecole La Decouverte-De-Saint-Sauveur** | Speed limit change from 80km/h to 50km/h a few metres before school zone sign |
| **Upper Miramichi Elem.** | No speed limit change (80km/h throughout), nicer road |
| **Back Bay Elementary** | Speed limit change from 80km/h to 50km/h a few metres before school zone sign |
| **Bonar Law Memorial High** | Speed limit change from 80km/h to 50km/h a few metres before school zone sign |